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(54) **DEVELOPER SUPPLY DEVICE WITH WALL BETWEEN CHAMBERS HAVING TWO HEIGHTS**

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USPC 399/349, 351, 358, 103, 284, 287, 279, 399/281, 254, 255, 256, 291, 30
See application file for complete search history.

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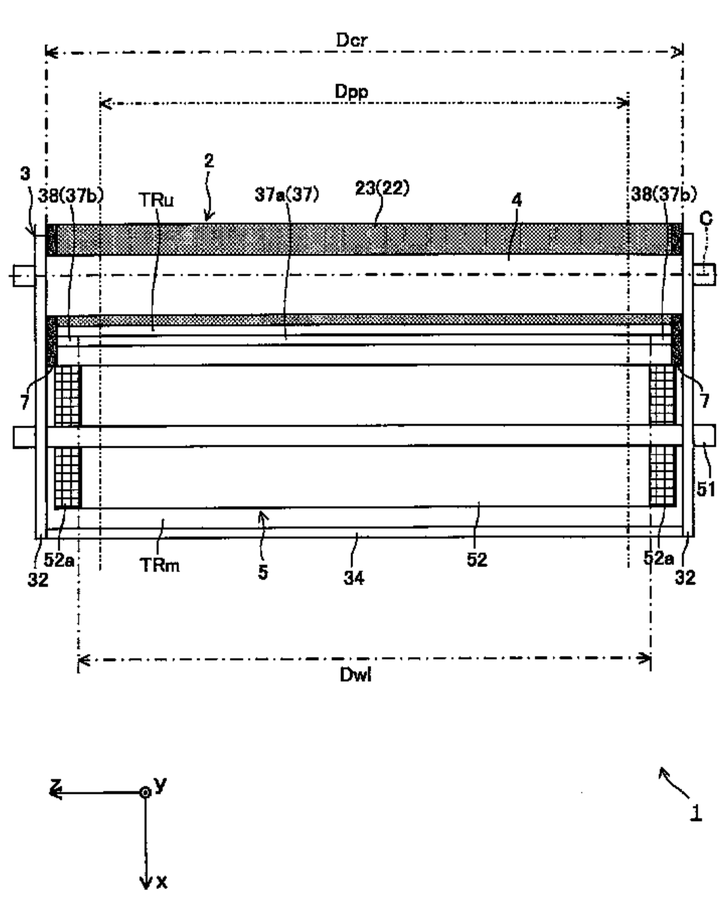
(57) **ABSTRACT**

A developer supply device including a developer carrying body, extending in a width direction, configured to carry developer and a casing including an wall, extending in the width direction, disposed between a first room on which the developer carrying body is disposed and a second room configured to store the developer is provided. The first room and the second room communicate each other through an opening formed above the wall. The wall includes end portions having a first height and a central portion. The central portion is disposed between the end portions and has a second height which is higher than the first height.

18 Claims, 10 Drawing Sheets



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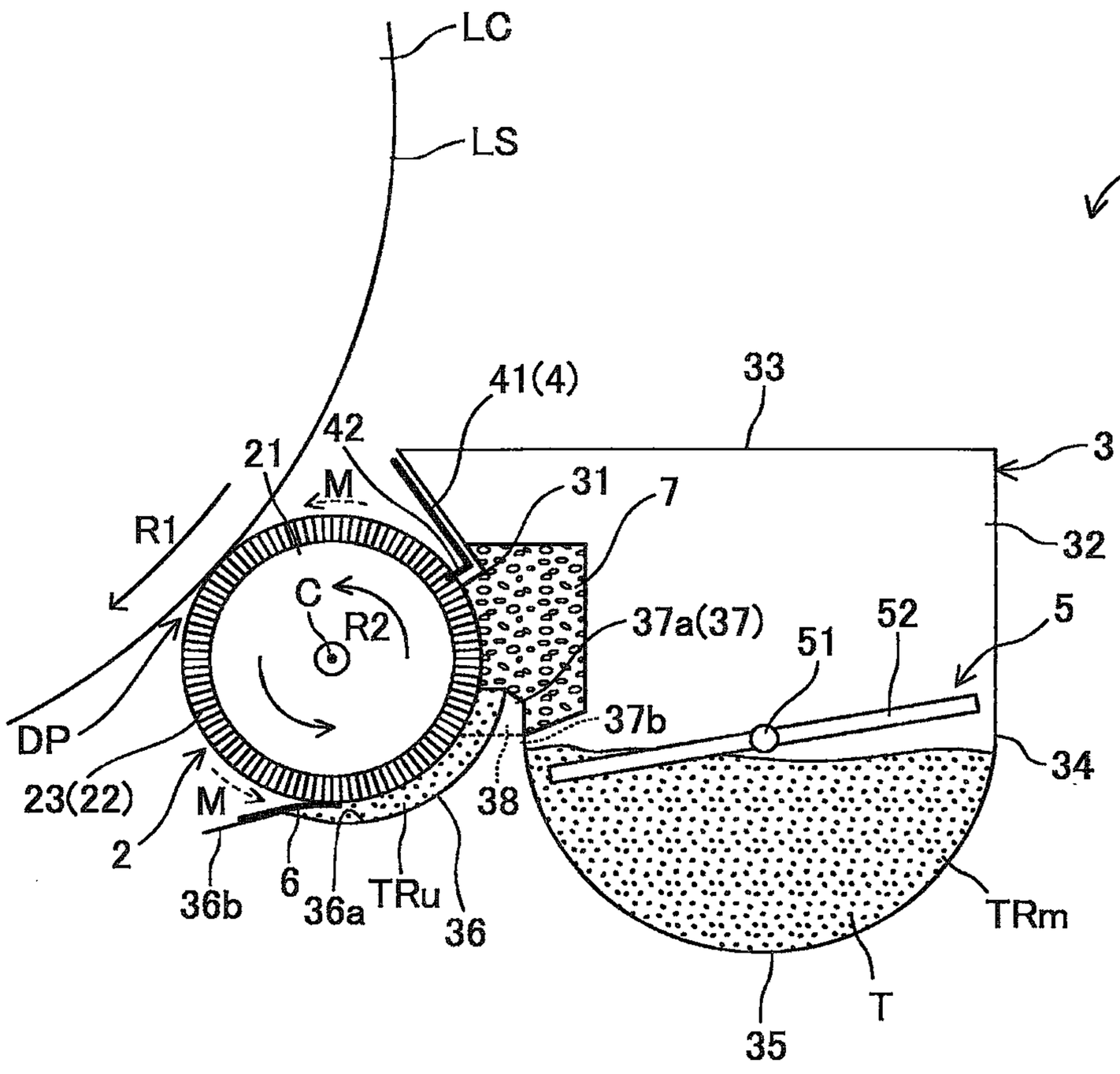
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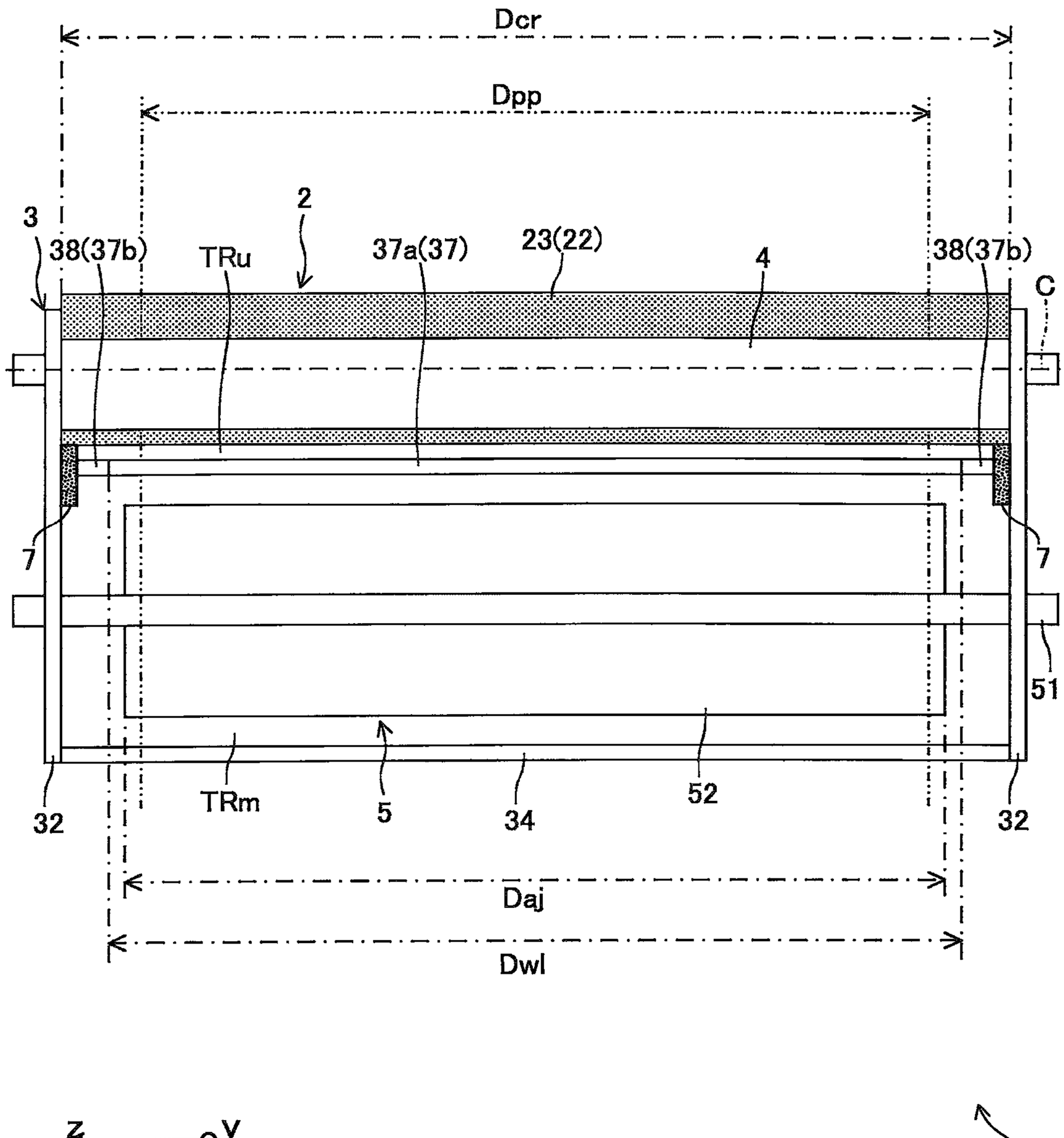
LS
1
41(4)
33
42
21
3
M
31
7
R1
32
C
R2
37a(37)
52
5
51
DP
37b
34
23(22)
M
38
2
6
36b
36a
TRu
36
TRm
35
T

FIG. 1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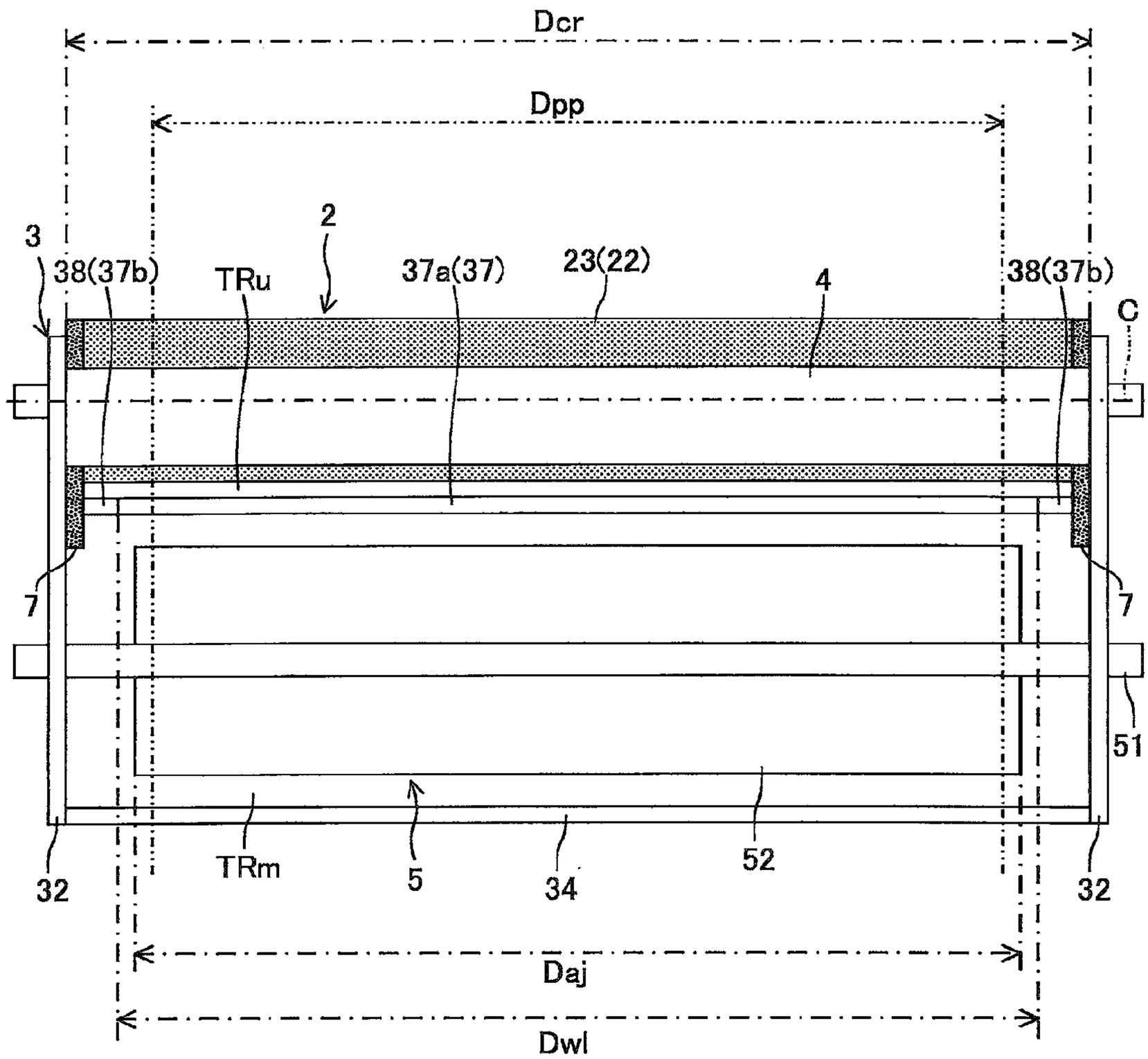
Dpp
2
3
38(37b)
TRu
37a(37)
23(22)
4
38(37b)
C
7
7
51
32
TRm
5
34
52
32
Daj
Dwl
z
y
x
1

FIG. 2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Dpp
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3
38(37b)
TRu
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4
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C
7
7
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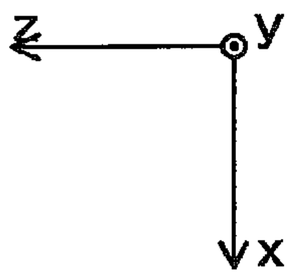
32
TRm
5
34
52
32
Daj
Dwl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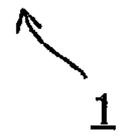
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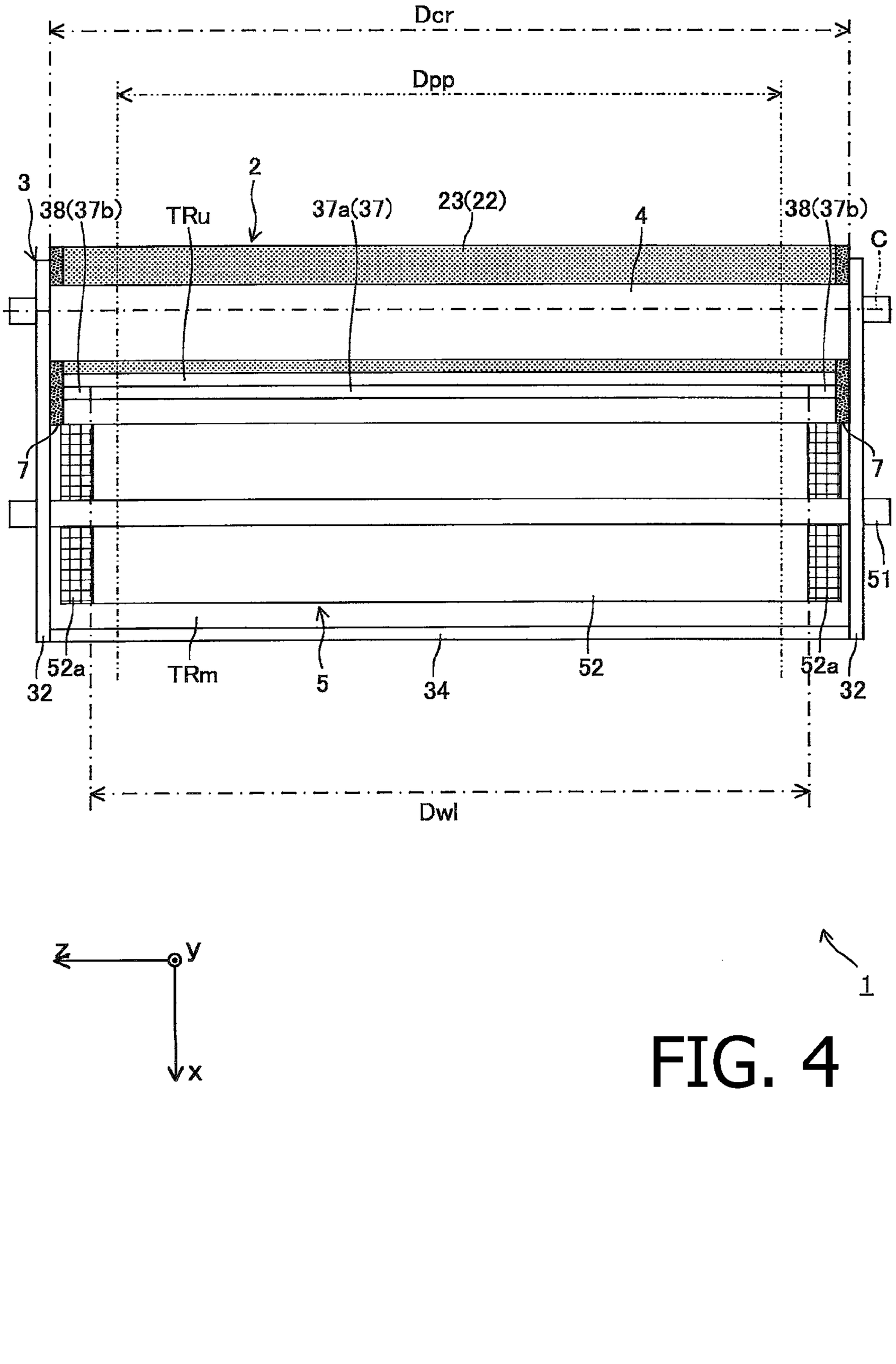
FIG. 3


Dcr
Dpp
3
38(37b)
TRu
2
37a(37)
23(22)
4
38(37b)
C
7
7
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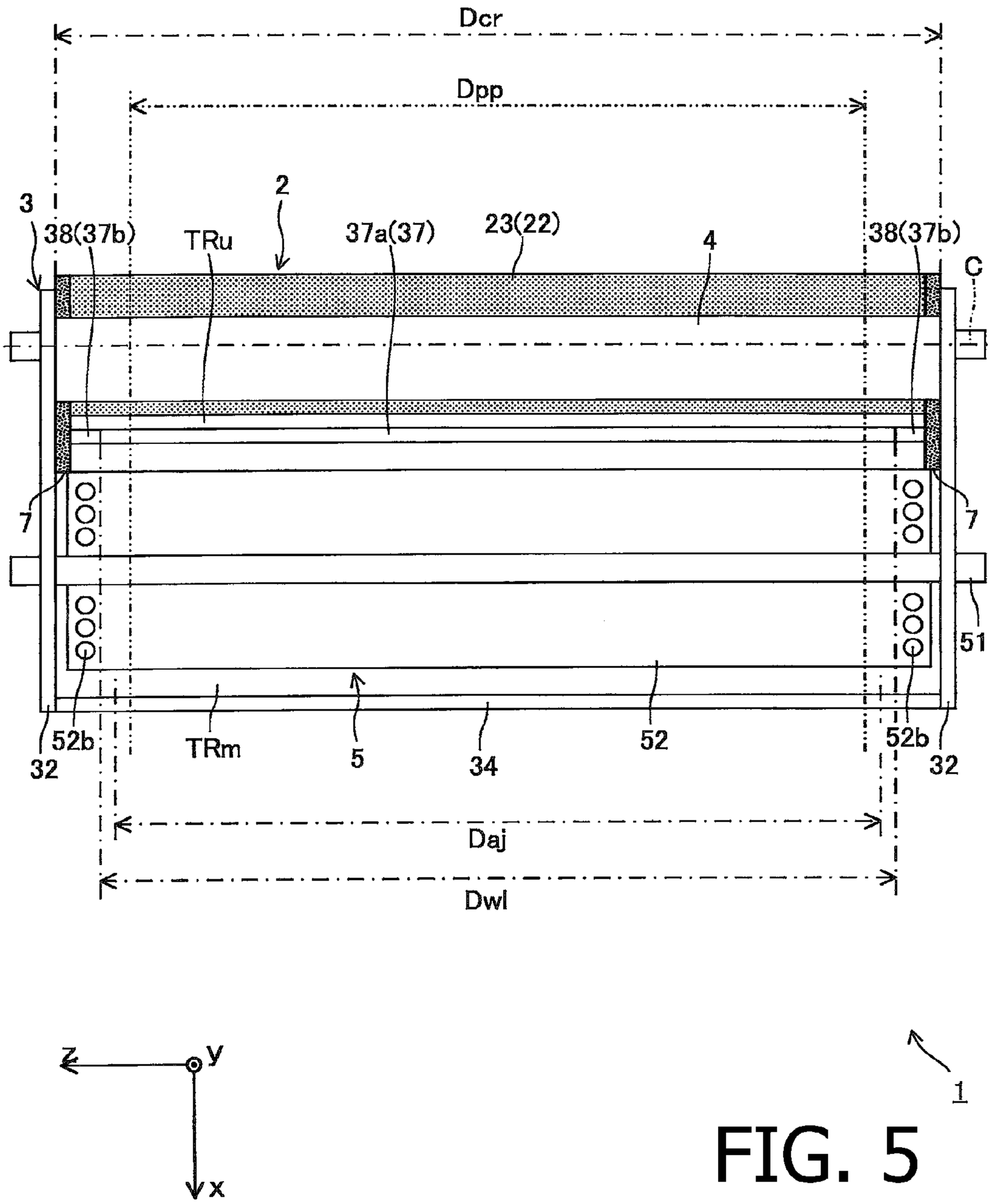
52a
TRm
5
34
52
52a
32
32
Dwl
z
y
x
1

FIG. 4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Dpp
3
2
38(37b)
TRu
37a(37)
23(22)
4
38(37b)
C
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7
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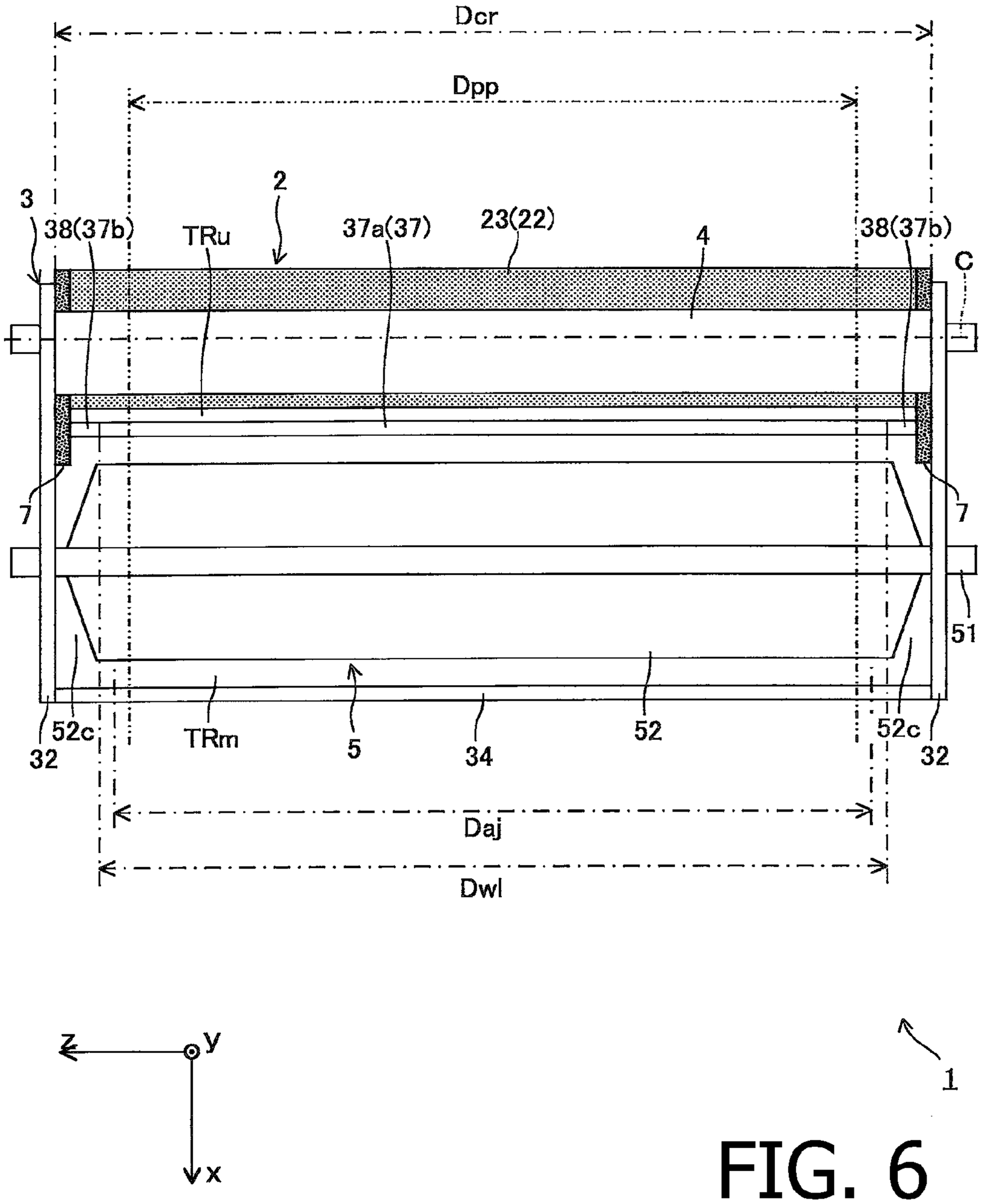
52b
TRm
5
34
52
52b
32
32
Daj
Dwl
z
y
x
1

FIG. 5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Dpp
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TRu
2
37a(37)
23(22)
4
38(37b)
C
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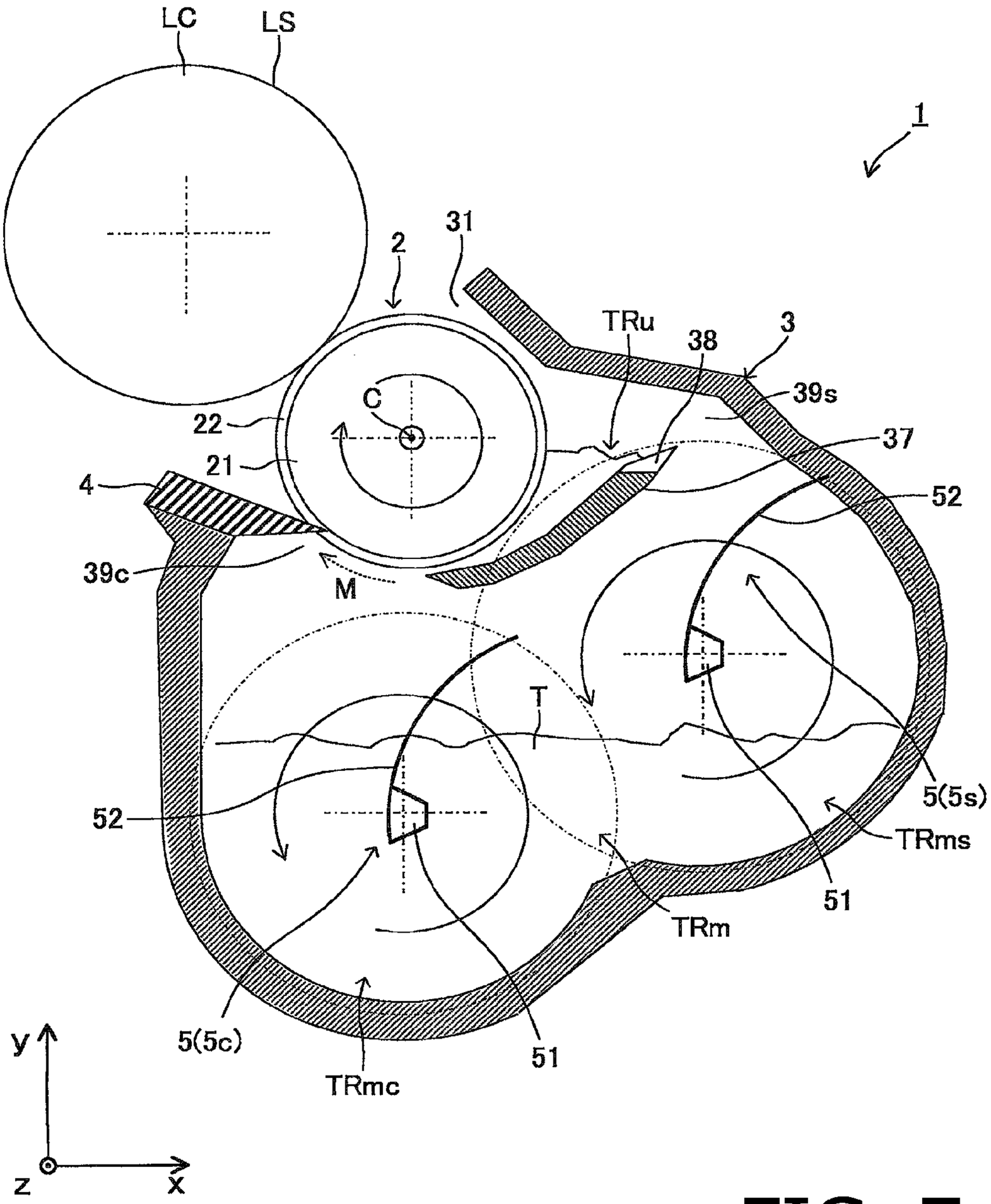
32
Daj
Dwl
z
y
x
1

FIG. 6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LS
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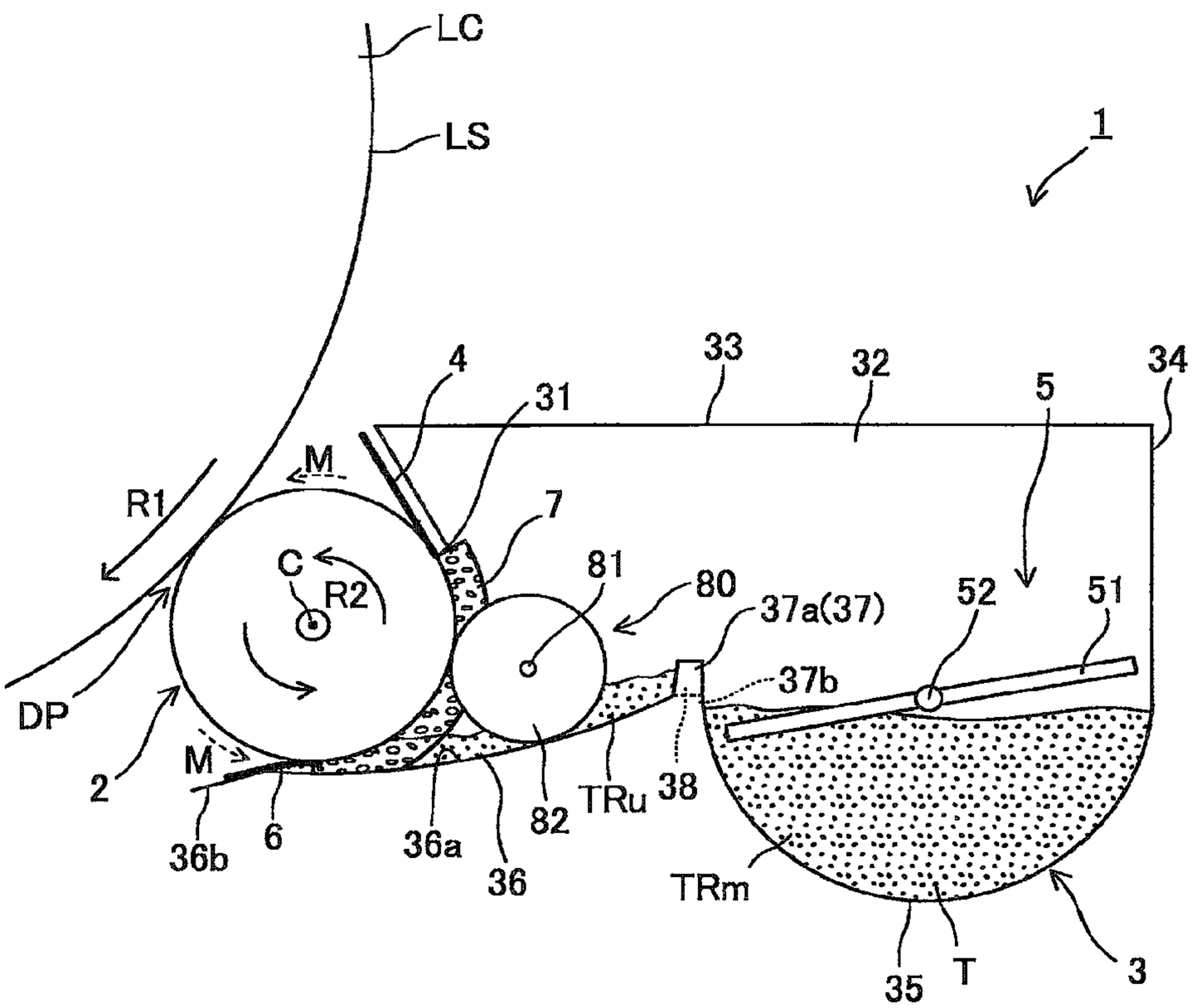
31
2
TRu
38
3
39s
C
22
37
21
4
52
39c
M
T
52
5(5s)
TRms
51
TRm
5(5c)
TRmc
51
y
z
x

FIG. 7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LS
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4
31
33
32
5
34
M
R1
7
C
R2
81
80
37a(37)
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36a
36
82
TRu
38
TRm
35
T
3

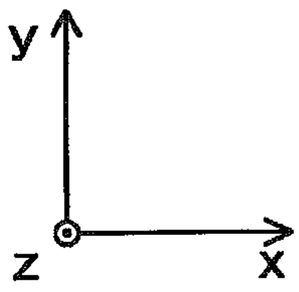
y
z
x

FIG. 8

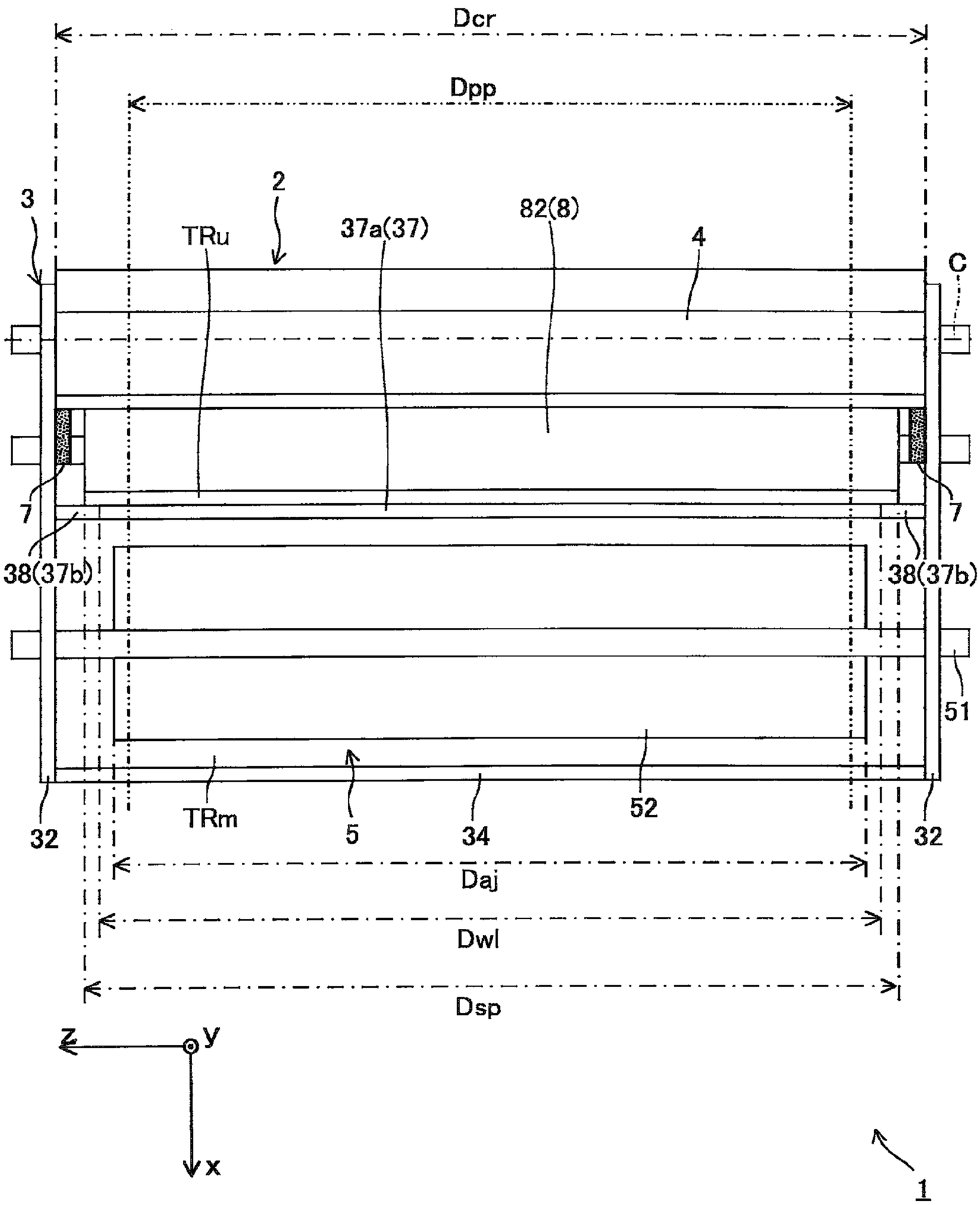
Dcr
Dpp
3
2
TRu
37a(37)
82(8)
4
C
7
7
38(37b)
38(37b)
51
TRm
5
34
52
32
32
Daj
Dwl
Dsp
Z
y
x
1

FIG. 9

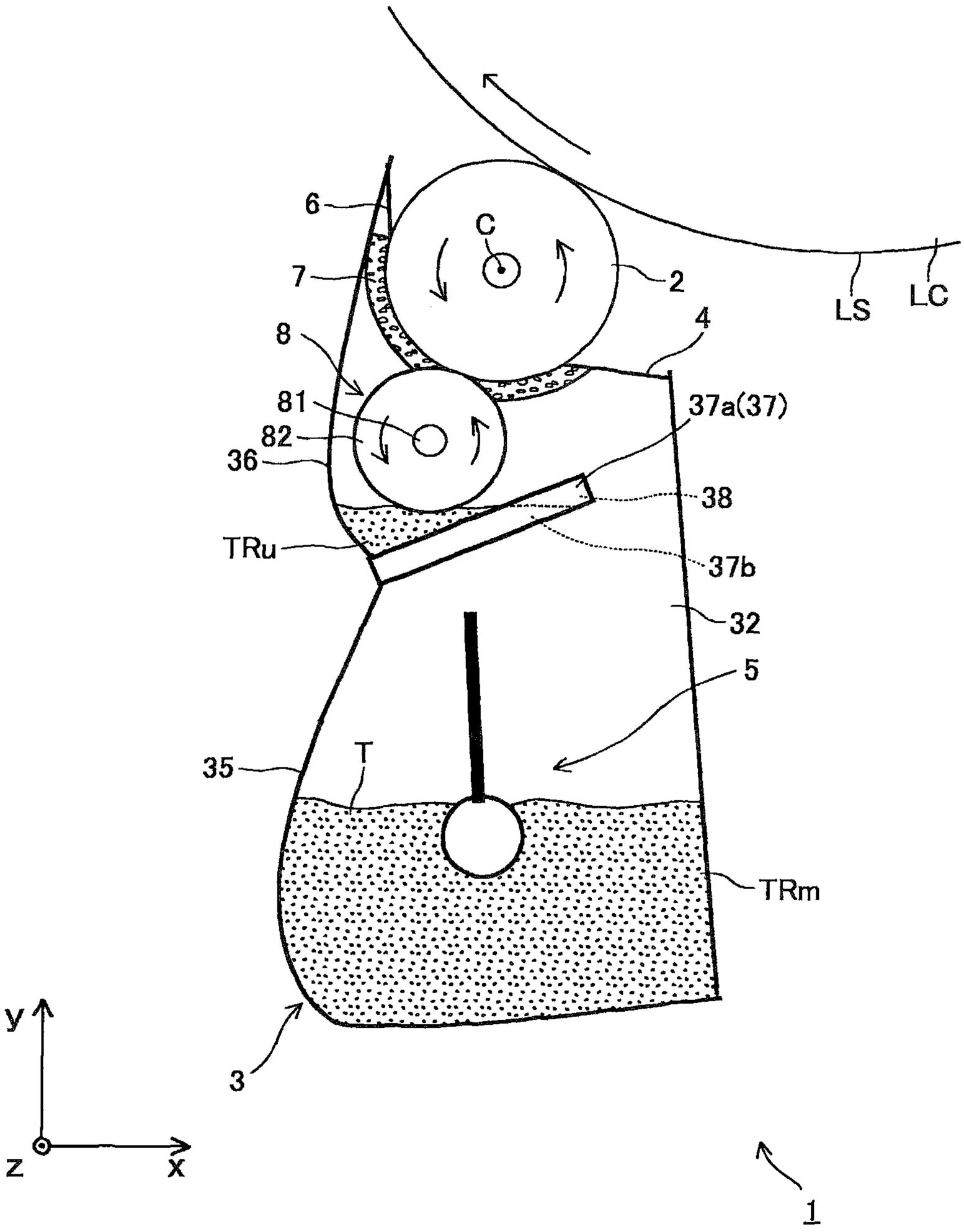

FIG. 10

DEVELOPER SUPPLY DEVICE WITH WALL BETWEEN CHAMBERS HAVING TWO HEIGHTS

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority under 35 U.S.C. §119 from Japanese Patent Applications No. 2012-156063 filed on Jul. 12, 2012. The entire subject matter of the application is incorporated herein by reference.

BACKGROUND

1. Technical Field

The following description relates to a developer supply device configured to supply dry-type developer (i.e., powdered developer) to an intended object.

2. Related Art

Various kinds of developer supply devices have been known. Specifically, a developer supply device including a so-called "brush roller" used as a developer carrying body a development roller) has been known.

SUMMARY

Aspects of the present invention are advantageous to provide a developer supply device which is capable of handling developer in a favorable manner (e.g., suppressing a leakage of the developer and carrying the developer appropriately).

According to aspects of the present invention, a developer supply device including a developer carrying body, extending in a width direction, configured to carry developer and a casing including an wall, extending in the width direction, disposed between a first room on which the developer carrying body is disposed and a second room configured to store the developer is provided. The first room and the second room communicate each other through an opening formed above the wall. The wall includes end portions having a first height and a central portion. The central portion is disposed between the end portions and has a second height which is higher than the first height.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

FIG. **1** is a cross-sectional side view schematically showing a configuration of a toner supply device in an embodiment according to one or more aspects of the present invention.

FIG. **2** is a plane view showing the toner supply device shown in FIG. **1**.

FIG. **3** is a plane view showing a first modification of the toner supply device shown in FIG. **2**.

FIG. **4** is a plane view showing a second modification of the toner supply device shown in FIG. **2**.

FIG. **5** is a plane view showing a third modification of the toner supply device shown in FIG. **2**.

FIG. **6** is a plane view showing a fourth modification of the toner supply device shown in FIG. **2**.

FIG. **7** is a cross-sectional side view schematically showing a configuration of a fifth modification of the toner supply device shown in FIG. **1**.

FIG. **8** is a cross-sectional side view schematically showing a configuration of a sixth modification of the toner supply device shown in FIG. **1**.

FIG. **9** is a plane view showing the toner supply device shown in FIG. **8**.

FIG. **10** is a cross-sectional side view schematically showing a configuration of a seventh modification of the toner supply device shown in FIG. **8**.

DETAILED DESCRIPTION

Hereinafter, an embodiment according to aspects of the invention will be described with reference to the accompany drawings. It is noted that modifications for the embodiment will be described at ending so as to avoid misunderstanding of the embodiment.

<Configuration>

Hereinafter, a configuration of a toner supply device **1** in the embodiment will be described with reference to FIGS. **1** and **2**. It is noted that y-axis shown in drawings indicates a "vertical direction" that is parallel to a direction of gravitational force. Additionally, a positive direction of the y-axis indicates "upside" in the vertical direction.

A photoconductive drum LC, to which a developer is supplied in the embodiment, is a cylindrical member having a circumferential surface. The photoconductive drum LC is disposed rotatably about a central axis not shown) in a predetermined rotational direction R**1** (i.e., a clockwise direction in FIG. **1**). The central axis is parallel to z-axis shown in drawings, and the z-axis is parallel to a direction so-called "a main scanning direction" or "a sheet width direction." An electrostatic latent image carrying surface LS (hereinafter, referred to as an "image carrying surface LS"), on which an electrostatic latent image can be formed, is formed on the circumferential surface of the photoconductive drum LC. In the embodiment, length of the image carrying surface LS in the sheet width direction is equal to or longer than 210 mm so that maximum width of a recording sheet, on which an image can be recorded, is a width of "A4" size sheet of which a sheet width Dpp is 210 mm.

The toner supply device **1** is configured to supply toner T onto the image carrying surface LS formed on the circumferential surface of the photoconductive drum LC. The toner T is dry-type non-magnetic monocomponent developer (i.e., powdered non-magnetic monocomponent developer). The toner supply device **1** is configured to supply the toner T a development position DP of the image carrying surface LS so that an electrostatic latent image formed on the image carrying surface LS is developed, by the toner T. The toner supply device **1** includes a development roller **2**, a casing **3**, a restricting member **4**, an agitator **5**, a lower seal member **6** and side seal members **7**.

The development roller **2** is a so-called "brush roller" which has a well-known configurations. Specifically, the development roller **2** includes a roller body **21** and a brush layer **22**.

The roller body **21** is a cylindrical member having a circumferential surface. The brush layer **22** is formed on the circumferential surface of the roller body **21**. The brush layer **22** has a plurality of fibrous members **23** attached on the circumferential surface of the roller body **21**. The development roller **2** is configured to rotate about a development roller central axis C in a predetermined rotating direction R**2** (i.e., a direction opposite to the rotational direction R**1** and an anticlockwise direction in FIG. **1**) with carrying the toner T on the brush layer **22**. The development roller central axis C is parallel to the central axis of the photoconductive drum LC (not shown).

In the embodiment, the fibrous members **23** of the brush layer **22** are attached to the circumferential surface of the roller body **21** by electrostatic flocking. The fibrous members **23** are formed to be substantially straight when no external

loading (i.e., loading applied by contacting the photoconductive drum LC) is applied to the fibrous members **23**.

In the embodiment, the development roller **2** is disposed to face the photoconductive drum LC so that the brush layer **22** contact the image carrying surface LS at the development position DP. The "development position DP" is a position where the photoconductive drum LC and the development roller **2** face and contact each other. When the development roller **2** rotates in the rotational direction R**2**, the brush layer **22** moves to a direction orthogonal to the development roller central axis C (see "a movement direction M" indicated in an arrow in broken line in FIG. **1**).

The casing **3** is a box member having an opening **31** extending along the development roller central axis C. The casing **3** is configured to store the toner T to be carried by the brush layer **22** in its inner space. In the embodiment, the opening **31** is formed on a lateral side of the casing **3**. The casing **3** rotatably supports the development roller **2**. The brush layer **22** is disposed at the opening **31** along the sheet width direction such that the brush layer **22** contacts the image carrying surface LS at the development position DP.

The casing **3** is made of rigid plastic (synthetic resin), such as polystyrene (i.e., the casing **3** is not made of elastic or sponge). The casing **3** includes a pair of side plates **32**, a top plate **33**, a rear plate **34**, a main bottom plate **35** and a sub bottom plate **36**. It is noted that, in the following description, only one reference number will be indicated for a plurality of components having the same reference numbers (e.g., the side plates **32**, **32**) for brevity.

The pair of side plates **32** are flat plate members disposed to be parallel with each other in a direction orthogonal to the development roller central axis C. In the embodiment, the development roller **2** is rotatably supported by the side plates **32** on the opening **31** side.

The top plate **33** is disposed to connect upper edges of the side plates **32** so as to cover a space between the side plates **32** from above. The rear plate **34** is disposed to connect rear edges of the side plates **32** and the top plate **33** so as to cover the space between the side plates **32** from a side opposite to a side on which the opening **31** is formed. The main bottom plate **35** and the sub bottom plate **36** integrally forms a bottom part of the casing **3**.

The main bottom plate **35** substantially has a semicylinder shape or a horseshoe shape viewed from a direction parallel to the z-axis (i.e., the main bottom plate **35** is formed to open upward). The main bottom plate **35** is disposed at a side opposite to a side on which the opening **31** is formed. The main bottom plate **35** defines a main toner storage room TRm which is the largest room to store the toner T to be carried by the brush layer **22** in the inner space of the casing **3**.

The sub bottom plate **36** is disposed below the development roller **2** and has a circular shape viewed from the direction parallel to the z-axis. The sub bottom plate **36** is formed to open obliquely upward so as to open toward the photoconductive drum LC. The sub bottom plate **36** is disposed to be adjacent to the main bottom plate **35** in a direction parallel to the x-axis. Specifically, the sub bottom plate **36** is closer to the opening **31** and disposed slightly higher than the main bottom plate **35**.

Between an inner wall **36***a* of the sub bottom plate **36** facing the brush layer **22** and the brush layer **22**, a clearance having a predetermined distance is formed. On a front end of the sub bottom plate **36** an upstream side end of the sub bottom plate **36** in the movement direction M), a lower seal fixing part **36***b* is formed. Additionally, a lower seal member **6** is fixed on the inner wall **36***a* side of the lower seal fixing part **36***b*.

The lower seal member **6** is an elongated sheet member extending along the development roller central axis C. Specifically, the lower seal member **6** is a plastic member such as polyester, and it may be referred to as a "lower film." The lower seal member **6** is disposed below the development roller **2** and contacts the brash layer **22** throughout the length of the brush layer **22** in the sheet width direction to prevent leakage of the toner T from the lower side of the opening **31** to outside. The lower seal member **6** is cantilevered on the lower seal fixing part **36***b* so as to extend along the movement direction M viewed from the direction parallel to the z-axis.

The sub bottom plate **36** defines a roller side toner storage room TRu for storing the toner T between the sub bottom plate **36** and the brush layer **22**. Specifically, the roller side toner storage room TRu, which stores the toner T to be carried by the development roller **2**, is defined by the lower side of the development roller **2**, the lower seal member **6** and the inner wall **36***a* of the sub bottom plate **36**.

In the embodiment, the roller side toner storage room TRu is disposed below the development roller **2** (i.e., below the development roller central axis C) along the brush layer **22**. The roller side toner storage room TRu has length corresponding to the length of the brush layer **22** in the sheet width direction. In addition, the roller side toner storage room TRu is disposed obliquely upward of the main toner storage room TRm.

A dividing wall **37** is disposed between the main bottom plate **35** and the sub bottom plate **36**. The dividing wall **37** is formed to project upward (i.e., toward an inner space of the casing **3**) to divide the roller side toner storage room TRu and the main toner storage room TRm. In the embodiment, the dividing wall **37** extends from one of the side plates **32** to the other of the side plates **32** along the sheet width direction.

Additionally, in the embodiment, the dividing wall **37** includes a higher projecting part **37***a* and at least one lower projecting part **37***b*. The higher projecting part **37***a* is disposed on a center part of the dividing wall **37** in the sheet width direction. The height of the lower projecting part **37***b* in the vertical direction is lower than that of the higher projecting part **37***a*. The lower projecting part **37***b* is disposed at least one of end portions of the dividing wall **37** in the sheet width direction. In the embodiment, two lower projecting parts **37***b* are disposed at both end portions of the dividing wall **37** in the sheet width direction. The cutout portions formed on both end portions of the dividing wall **37** in the sheet width direction (i.e., portions corresponding to the lower projecting parts **37***b*) define toner passages **38**.

The toner T can be conveyed between the roller side toner storage room TRu and the main toner storage room TRm over an upper edge of the higher projecting part **37***a*. Additionally, the toner T can flow between the roller side toner storage room TRu and the main toner storage room TRm through the toner passages **38** (i.e., downward of the upper edge of the higher projecting part **37***a*). The upper edges of the lower projecting parts **37***b* are formed to be stepped, with respect to the upper edge of the higher projecting part **37***a*, in a direction opposite to a direction that the higher projecting part **37***a* is projected.

The restricting member **4** restricts an amount of the tonner T carried by the brush layer **22** by removing a part of the toner T temporarily carried by the brush layer **22**. The restricting member **4** is disposed to face the development roller **2** so as to contact the brush layer **22** at an upstream side in the movement direction M of the brush layer **22** of the development roller **2**. The restricting member **4** includes a blade part **41** and a restricting part **42**.

The blade part **41** is a plate-dike member fixed at the opening **31** side edge of the top plate **33** of the casing **3**. The blade part **41** is disposed to extend from the downstream side to the upstream side of the movement direction M. The restricting part **42** is disposed on a leading edge of the blade part **41** in a direction that the blade part **41** extends. The restricting part **42** extends from the leading edge of the blade part **41** to the development roller central axis C no as to penetrate into the brush layer **22**.

Specifically, the restricting member **4** is integrally formed by bending a thin metal plate, such as stainless steel. The restricting member **4** is disposed so that the restricting part **42** contacts the brush layer **22** above the roller side toner storage room TRu and at a downstream side of the roller side toner storage room TRu in the movement direction M. The restricting member **4** extends from the downstream side to the upstream side of the rotational direction R**2** of the development roller **2** (i.e., extends to a direction opposite to the movement direction M) so as to direct the removed toner T to the main toner storage room TRm.

The agitator **5** is accommodated in the main toner storage room TRm to agitate the toner T stored in the main toner storage room TRm. The agitator **5** conveys the toner T from the main toner storage room TRm to the roller side toner storage room TRu over the dividing wall **37** (mostly, over the higher projecting part **37***a*). The agitator **5** includes an agitator central shaft **51** and rotating members **52**.

The agitator central shaft **51** is a round bar member disposed parallel to the development roller central axis C. The agitator central shaft **51** is rotatably supported by the pair of the side plates **32**.

The rotating members **52** are disposed in the main toner storage room TRm The rotating members **52** are fixed to the agitator central shaft **51** so that the rotating members **52** move in the main toner storage room TRm (i.e., rotates about the agitator central shaft **51**) as the agitator central shaft **51** rotating in a predetermined direction (i.e., a clockwise direction in FIG. **1**). In the embodiment, two rotating members **52** are symmetrically fixed to the agitator central shaft **51**.

In the embodiment, the toner supply device **1** is configured to satisfy a following relationship as shown in FIG. **2**, when Dcr is length of the brush layer **22** in the sheet width direction, Dwl is length of the higher projecting part **37***a* of the dividing wall **37** in the sheet width direction (i.e., length of a portion of the dividing wall **37** on which the toner passages **38** are not formed), and Daj is length of the rotating member **52** in the sheet width direction.

$$Dcr>Dwl>Daj\geq Dpp$$

The pair of side seal members **7** are disposed at both ends of the opening **31** in the sheet width direction to prevent leakage of the toner T from the opening **31**. Specifically, in the embodiment, the side seal members **7** are disposed to contact the both ends of the circumferential surface of the brush layer **22** in the sheet width direction. The side seal members **7** are fixed on the inner wall of the side plates **32** of the casing **3** with a double sided tape, and the like.

In the toner supply device **1** of the above embodiment, the agitator **5** is driven to rotate in the predetermined direction (e.g., a clockwise direction in FIG. **1**) and the toner T is lifted (thrown up) by the rotating members **52** moving upwards. Then, the toner T is conveyed from the main toner storage room TRm to the roller side toner storage TRu over the dividing wall **37** (mostly, the higher projecting part **37***a*).

The toner T stored in the roller side toner storage room TRu is supplied to the circumferential surface of the development roller **2** (i.e., the brush layer **22** in the embodiment, the same shall apply hereinafter) which moves in the movement direction M with a rotation of the development roller **2**. The circumferential surface of the development roller **2** carries the toner T at a position facing the roller side toner storage room TRu. The circumferential surface of the development roller **2** contacts the restricting member **4** when it further moves in the movement direction M with the rotation of the development roller **2**. Then, the amount of the toner T carried by the circumferential surface of the development roller **2** (i.e., the brush layer **22**) is restricted (adjusted) by the restricting member **4**.

After the amount of the toner T is restricted by the restricting member **4**, the circumferential surface of the development roller **2** carrying the toner T further moves in the movement direction M with the rotation of the development roller **2** and reaches the development position DP. At the development position DP, the toner T carried by the circumferential surface of the development roller **2** is supplied to the image carrying surface LS. After the toner T is supplied to the image carrying surface LS, the circumferential surface of the development roller **2** moves in the movement direction M with the rotation of the development roller **2** and reaches a position facing the roller side toner storage room TRu again.

As described above, during the rotation of the development roller **2**, the leakage of the toner T from the downward of the opening **31** of the casing **3** is prevented by the lower seal member **6** which contacts the circumferential surface of the development roller **2**. Additionally, the leakage of the toner T from the ends of the opening **31** in the sheet width direction is prevented by the side seal members **7** which contact the circumferential surface of the development roller **2**.

Here, it is assumed a case where the amount of the toner T in the roller side toner storage room TRu becomes excessive for some reasons (it is noted that such a case would be suppressed immediately in the embodiment, as described later). For example, such a case might happen when an area of an image to be formed on the image carrying surface LS is small and such a situation is continued for a relatively long period.

In such a case, the toner T might leak from the opening **31** (especially, from a clearance between the side seal member **7** and the development roller **2**) to outside. Additionally, since the "brush roller" is used as the development roller **2** in the embodiment, the toner T could be pressed into the brush layer **22** and a large amount of the toner T could be jammed inside the fibrous members **23**. This might cause a defect so-called "fog" in a white background. The fog in the white background becomes outstanding as the number of the operations (i.e., the number of image forming operation) increases.

In contrast, according to the toner supply device **1** in the embodiment, the toner passages **38** are formed at both end portions of the dividing wall **37** in the sheet width direction. Therefore, the tanner T may flow from the roller side toner storage room TRu to the main toner storage room TRm through the toner passages **38** when the amount of the tanner T in the roller side toner storage room TRu becomes mass.

Additionally, the toner supply device **1** in the embodiment satisfies the relationship "Dcr>Dwl≥Daj." That is, the rotating members **52** of the agitator **5** do not face the toner passages **38** in the embodiment. Therefore, the toner T is conveyed from the main toner storage room TRm to the roller side toner storage room TRu by the agitator **5** mostly over the higher projecting part **37***a*, and the toner T may return from the roller side toner storage room TRu to the main toner storage room TRm through the toner passages **38**.

Thus, according to the toner supply device **1** of the embodiment, the amount of the toner T in the roller side toner storage room TRu may be adjusted by the contribution of the toner

passage **38**. Therefore, the case where the amount of the tanner T in the roller side toner storage room TRu becomes excessive can be prevented. Further, durability of the toner T can be improved since the toner T may circulate between the roller side toner storage room TRu and the main toner storage room TRm favorably.

As described above, according to the toner supply device **1** of the embodiment, the toner T can be handled in a favorable manner, and the leakage of the toner T from the opening **31** to the outside can be prevented. As a result, an image forming (i.e., development of the electrostatic latent image) can be performed appropriately.

<Examples of Modifications>

Hereinabove, the embodiment according to aspects of the present invention has been described. The present invention can be practiced by employing conventional materials, methodology and equipment. Accordingly; the details of such materials, equipment and methodology are not set forth herein in detail. In the previous descriptions, numerous specific details are set forth, such as specific materials, structures, chemicals, processes, etc., in order to provide a thorough understanding of the present invention. However, it should be recognized that the present invention can be practiced without reapportioning to the details specifically set forth. In other instances, well known processing structures have not been described in detail, in order not to unnecessarily obscure the present invention.

Only an exemplary embodiment of the present invention and a few examples of their versatility are shown and described in the present disclosure. It is to be understood that the present invention is capable of use in various other combinations and environments and is capable of changes or modifications within the scope of the inventive concept as expressed herein. For example, the following modifications are possible. In the following modifications, the same reference numbers are put to components having the same functions as the above described embodiment.

The intended object to which the developer is supplied, is not limited to the photoconductive drum. Aspects of the present invention may apply to a photoconductive body formed in a shape of a plate or an endless belt. Furthermore, aspects of the present invention may be applied to image forming apparatuses employing methods (such as a toner-jet method, an ion flow method, and a multi-stylus electrode method using no photoconductive body) other than the aforementioned electrophotographic method. In this case, image forming media such as papers, aperture electrodes or the like would be the intended object.

The restricting member **4** can be made of a materials other than the metal. For example, the restricting member **4** may be made of plastic. In this case, an electrically-conductive plastic may be used for the restricting member **4** to suppress electrostatic charge.

Additionally, only one toner passage **38** may be disposed at one of the end portions of the dividing wall **37** in the sheet width direction. Further, the toner passage **38** may be formed as a penetrating hole. That is, an upper edge of the toner passage **38** (an edge of the dividing wall **37** in the projecting direction) may be covered.

As shown in FIG. **3**, the side seal members **7** may be disposed to contact edge faces (i.e., a surface orthogonal to the development roller central axis C) of the development roller **2** (the brush layer **22**) from outside in the sheet width direction. That is, the each side seal member **7** may be held between the edge face of the development roller **2** the brush layer **22**) and the side plate **32** of the casing **3**.

In the above embodiment, the rotating members **52** of the agitator **5** are disposed not to face the toner passages **38** (i.e., Dcr>Dwl≥Daj) so that the toner T flows from the roller side toner storage room TRu to the main toner storage room TRm through the toner passages **38**. However, the invention may not be limited to such a configuration.

For example, the agitator **5** (the rotating member **52**) may be formed so that force to convey the toner T from the main toner storage room TRm to the roller side toner storage room TRu is weaker by a portion (position) of the rotating member **52** facing the toner passage **38** than by the other portion (position) of the rotating member **52** (i.e., a portion which does not face the toner passage **38**). Specifically, the rotating member **52** may have a different shape in a portion facing the toner passage **38**. FIGS. **4** though **6** show modifications of the rotating member **52**.

As shown in FIG. **4**, the rotating members **52** may have mesh portions **52***a* having a plurality of small holes in positions facing the toner passages **38**. Alternatively, the rotating members **52** may have a plurality of penetrating holes **52***b* in positions facing the toner passages **38** as shown in FIG. **5**. In this regard, one or more penetrating holes **52***b* may be formed on the rotating members **52**. Additionally, the plurality of penetrating holes can be arranged arbitrarily.

Alternatively, the rotating members **52** may have cutout parts **52***c* (i.e., a part where the rotating member **52** is cut out) in positions facing the toner passages **38** as shown in FIG. **6**. In this case, the cutout part **52***c* may have a triangular shape as shown in FIG. **6** or a rectangular shape (i.e., a shape like a stair case).

In the modifications shown in FIGS. **4** through **6**, the toner T is mostly conveyed from the main toner storage room TRm to the roller side toner storage room TRu by the center portion of the rotating members **52** on which the mesh parts **52***a* and the like are not formed (i.e. a part of which force to convey the tonner T is strong). According to this configuration, the toner T is mostly conveyed from the main toner storage room TRm to the roller side toner storage room TRu over the portion other than the toner passage **38** of the dividing wall **37** (i.e., the higher projecting part **37***a*).

On the other hand, the mesh parts **52***a* and the like are formed on the portions facing the toner passages **38** of the rotating members **52**. Thus, the force to convey the toner T from the roller side toner storage room TRu to the main toner storage room TRm over the toner passages **38** is weak. Therefore, the toner T may flow from the roller side toner storage room TRu to the main toner storage room TRm. According to this configuration, the toner T can be handled in a favorable manner similarly to the above embodiment even if the width of the rotating members **52** of the agitator **5** is wider than the width of the portion of the dividing wall **37** on which the toner passages **38** are not formed (i.e., the higher projecting part **37***a*).

Additionally, the configurations of the casing **3** and the agitator **5** may not limited to the above embodiment and modifications.

For example, a plurality of the agitators **5** may be accommodated in the main toner storage room TRm as shown in FIG. **7**. The shape of the agitator central shaft **51** may not limited to the round bar. Further, the rotating members **52** may be fixed to the agitator central shaft **51** asymmetry. For example, one edge of the one rotating member **52** may be fixed to the agitator central shaft **51**.

As shown in FIG. **7**, the opening **31** may be formed to open substantially upward (upward or obliquely upward). In this case, the roller side toner storage room TRu is disposed above (almost directly above) the main toner storage room TRm.

Hereinafter, detailed configuration of a modification of the toner supply device **1** shown in FIG. **7** will be described. In the modification, a collecting side main toner storage room TRmc and a supplying side main toner storage room TRms are disposed below the roller side toner storage room TRu in the casing **3**. The collecting side main toner storage room TRmc and the supplying side main toner storage room TRms are adjacent to each other. It is noted that a rotational direction of the development roller **2** in the modification is opposite to the rotational direction R**2** in the above embodiment (i.e., a clockwise direction in FIG. **7**).

The collecting side main toner storage room TRmc is disposed at the lowest part of the casing **3** and substantially directly below the roller side toner storage room TRu. The supplying side main toner storage room TRms is disposed obliquely above the collecting side main toner storage room TRmc and obliquely below the roller side toner storage room TRu.

In the modification, the roller side toner storage room TRu is disposed to be adjacent to and obliquely below the development roller **2**. Inside the casing **3**, the dividing wall **37** which divides the supplying side main toner storage room TRms and the roller side toner storage room TRu is disposed. The roller side toner storage room TRu is formed between the development roller **2** and the dividing wall **37** for storing the toner T. The roller side toner storage room TRu is disposed between the development roller **2** and the supplying side main toner storage room TRms.

A toner supplying passage **39***s* is formed between the supplying side main toner storage room TRms side edge of the dividing wall **37** and the inner wall of the casing **3**. Additionally, a toner collecting passage **39***c* is formed between the roller side toner storage room TRu side edge of the dividing wall **37** and the inner wall of the casing **3**. The toner collecting passage **39***c* is disposed downstream side of the toner supplying passage **39***s* in the movement direction M of the brush layer **22** of the development roller **2**.

In the modification, the toner supplying passage **39***s* is formed to allow the supplying side main toner storage room TRms to communicate with the roller side toner storage room TRu. Further, similarly to the above embodiment, at least one toner passage **38** is formed on the supplying side main toner storage room TRms side end portion of the dividing wall **37**. In the modification, two toner passages **38** are formed on both end portions of the dividing wall **37** in the sheet width direction.

In the modification, a clearance between the dividing wall **37** and the circumferential surface of the development roller **2** (the brush layer **22**) is defined as described below, in order to store a predetermined amount of the toner T in the roller side toner storage room TRu. The clearance in the toner collecting passage **39***c* side end is narrow so that the toner T hardly passes therethrough. On the other hand, the clearance in the toner supplying passage **39***s* side end is broader than that of the toner collecting passage **39***c* side end. That is, the clearance is widened from the toner collecting passage **39***c* side end toward the toner supplying passage **39***s* side end.

A collecting side agitator **5***c* is accommodated in the collecting side main toner storage room TRmc, and a supplying side agitator **5***s* is accommodated in the supplying side main toner storage room TRms. The collecting side agitator **5***c* conveys the toner T stored in the collecting side main toner storage room TRmc to the supplying side main toner storage room TRms with agitating the same. The supplying side agitator **5***s* conveys the toner T stored in the supplying side main toner storage room TRms to the roller side toner storage room TRu with agitating the same.

According to the configuration in the modification, the circumferential surface of the development roller **2**. (the brush layer **22**) is immersed in the toner T stored in the roller side toner storage room TRu so that the toner T is temporarily carried by the brush layer **22**. Then, a part of the toner T carried by the brush layer **22** is removed by the restricting member **4** and accumulated in the underlying collecting side main toner storage room TRmc through the toner collecting passage **39***c*.

The toner T stored in the collecting side main toner storage room TRmc is conveyed to the supplying side main toner storage room TRms while it is favorably fluidized by the agitation with the collecting side agitator **5***c*. The toner T stored in the supplying side main toner storage room TRms is conveyed to the roller side toner storage room TRu while it is favorably fluidized by the agitation with the supplying side agitator **5***s*.

According to the configuration of the modification, the toner T may flow from the roller side toner storage room TRu to the supplying side main toner storage room TRms through the toner passages **38** formed on the end portions of the dividing wall **37** in the sheet width direction. Thus, an amount of the toner T in the roller side toner storage room TRu is adjusted favorably by the contribution of the toner passage **38**.

Additionally, the invention is not limited to the configuration in which a so-called "brush roller" is used as the development roller **2**. For example, the circumferential surface of the development roller **2** may be formed as elastic layer, plastic layer, or metallic layer instead of the brush layer **22** (hereinafter, referred to as a "solid roller"). FIGS. **8** through **10** show modifications which use the solid roller as the development roller **2**.

As shown in FIG. **8**, a supplying roller **80** is disposed in the casing **3** when the "solid roller" is used as the development roller **2**. The supplying roller **80** is disposed to face the roller side toner storage room TRu so that a part of the supplying roller **80** is immersed in the toner T stored in the roller side toner storage room TRu. The supplying roller **80** supplies the toner T to the circumferential surface of the development roller **2**. The supplying roller **80** may be a sponge roller or a brush roller. The supplying roller **80** is a rotating member disposed parallel to the development roller central axis C between the development roller **2** and the dividing wall **37**. The supplying roller **80** is driven to rotate for supplying the toner T in the roller side toner storage room TRu to the circumferential surface of the development roller **2**.

Specifically, the supplying roller **80** includes around bar shaped supplying roller shaft **8** and a toner supplying layer **82** formed around the supplying roller shaft **81**. The toner supplying layer **82** may be formed by sponge or brush. The supplying roller **80** is disposed so that the toner supplying layer **82** contacts the circumferential surface of the development roller **2**.

In the configuration of the modification, the toner passages **38** are formed on the end portions of the dividing wall **37** in the sheet width direction. The toner passages **38** allow the toner T to flow from the roller side toner storage room TRu to the supplying side main toner storage room TRms, similarly to the above embodiment. Thus, an amount of the toner T in the roller side toner storage room TRu is adjusted by having the contribution of the toner passage **38**. Additionally, the case where the amount of the tonner T in the roller side toner storage room TRu becomes excessive can be prevented. Further, the toner T may circulate between the roller side toner storage room TRu and the main toner storage room TRm favorably.

Incidentally, the toner supply device **1** in the modification may be configured to satisfy the following relationship as shown in FIG. **9**, when Dsp is length of the supplying roller **80** (i.e., the toner supplying layer **82**) in the sheet width direction.

$$Dcr \geq Dsp > Dwl \geq Daj$$

Alternatively, the agitator **5** (the rotating members **52**) of the toner supply device **1** in the modification may be formed so that force to convey the toner T from the main toner storage room TRm to the roller side toner storage room TRu is weaker by a portion of the rotating member **52** facing the toner passage **38** than by the other portion of the rotating member **52** (i.e., a portion which does not face the toner passage **38**) as shown in FIGS. **4** through **6**. According to this configuration, the toner T can be handled in a favorable manner similarly to the above embodiment even if the width of the rotating member **52** of the agitator **5** is wider than the width of the portion of the dividing wall **37** on which the toner passages **38** are not formed (i.e., the higher projecting part **37***a*).

Additionally, the roller side toner storage room TRu and the main toner storage room TRm may be disposed to be adjacent each other along a direction parallel to the x-axis as shown in FIG. **8** or along a direction parallel to the y-axis as shown in FIG. **10**.

Further, the supplying roller **80** may be used in the toner supply device **1** which uses the "brush roller" as the development roller **2**. In other words, the brush roller shown in FIG. **1** may be used as the development roller **2** shown in FIGS. **8** and **10**.

What is claimed is:

1. A developer supply device, comprising:

a roller configured to carry developer, extending in a first direction the first direction being in a direction of a rotation axis of the roller and horizontal when the developer supply device is in use;

a casing in which a first room and a second room are defined, the roller being disposed in the first room, the second room being configured to store the developer;

a wall extending over a length of the casing in the first direction, the first room and the second room being partitioned by the wall, an opening being formed above the wall over the length of the wall when the developer supply device is in use; and

an agitator configured to convey the developer from the second room to the first room, the agitator including a shaft and a rotating member fixed to the shaft, the shaft being rotatably supported by the casing and configured to rotate in the second room;

wherein the wall is divided into:

end portions which are both end portions, in the first direction, of the wall and having a first height at upper ends of the end portions; and

a central portion defined as a portion, between the end portions, having a predetermined length in the first direction and having a second height which is higher than the first height, the central portion having an upper end that is continuous with the upper ends of the end portions,

wherein the agitator is configured to convey the developer from the second room to the first room through at least a portion of the opening which is formed above at least the central portion of the wall,

wherein the developer conveyed over the wall accumulates in the first room,

wherein the roller is configured to collect the developer accumulated in the first room, and

wherein the rotating member of the agitator includes a central conveyance portion corresponding to the central portions of the wall and end conveyance portions respectively corresponding to the end portions of the wall, each of the end conveyance portions including a mesh part,

wherein the central conveyance portion has a different shape than the end conveyance portions so that a force to convey the developer from the second room to the first room is stronger by the central conveyance portion than by the each end conveyance portion,

wherein superfluous developer accumulated in the first room returns to the second room through at least portions of the opening which are formed above the end portions of the wall.

2. The developer supply device according to claim **1**, wherein the roller includes a shaft and a carrying part disposed around the shaft of the roller and configured to carry the developer,

wherein, when Dcr is a length of the carrying part of the roller in the first direction, Dwl is a length of the central portion of the wall in the first direction, and Daj is a length of the rotating member of the agitator in the first direction, the developer supply device satisfies a following relationship:

$$Dcr > Dwl \geq Daj.$$

3. The developer supply device according to claim **2**, further comprising a developer supplying member disposed between the roller and the wall and configured to supply the developer to the roller,

wherein the developer supplying member includes a shaft and a supplying part disposed around the shaft of the developer supplying member and configured to supply the developer,

wherein, when Dsp is a length of the supplying part of the developer supplying member in the first direction, the developer supply device satisfies a following relationship:

$$Dcr \geq Dsp > Dwl \geq Daj.$$

4. The developer supply device according to claim **1**, wherein the central conveyance portion has a different shape than the end conveyance portions.

5. The developer supply device according to claim **1**, wherein a circumferential surface of the roller is disposed near the wall with an interval.

6. The developer supply device according to claim **1**, wherein the rotation axis of the roller is disposed above the highest portion of the central portion of the wall when the developer supply device is in use.

7. The developer supply device according to claim **1**, further comprising a restricting member fixed to the casing and configured to remove a part of the developer carried by the roller so as to restrict an amount of the developer carried by the roller,

wherein the restricting member contacts a circumferential surface of the roller above the first room, downstream side of a movement direction of the circumferential surface of the roller and upstream side of a development position where the developer is supplied by the developer supply device.

8. The developer supply device according to claim **7**, wherein the restricting member directs the removed developer to the second room.

9. The developer supply device according to claim 1, further comprising side seal members disposed on both ends of the opening in the width direction to prevent leakage of the developer from the opening.

10. The developer supply device according to claim 1, further comprising a lower seal member disposed on a lower end of the first room when the developer supply device is in use, to prevent leakage of the developer from the lower end of the first room.

11. The developer supply device according to claim 1, wherein the roller is a brush roller including:

a roller body having a circumferential surface; and

a brush layer formed on the circumferential surface to carry the developer.

12. The developer supply device according to claim 11, further comprising a restricting member fixed to the casing and configured to remove a part of the developer carried by the roller so as to restrict an amount of the developer carried by the roller,

wherein the restricting member includes:

a fixing part fixed to the casing; and

a restricting part formed in an edge of the fixing part, the restricting part extending towards a central axis of the roller to contact the brush layer.

13. The developer supply device according to claim 1, wherein the roller comprises a development roller configured to contact a photoconductive drum and supply the developer to the photoconductive roller on which an electrostatic latent image is formed.

14. The developer supply device according to claim 1, further comprising a development roller,

wherein the roller comprises a supplying roller configured to contact the development roller and supply the developer to the development roller.

15. The developer supply device according to claim 2, wherein Daj is equal to a length of the rotating member of the agitator between a first end and a second end in the first direction.

16. The developer supply device according to claim 1, wherein the agitator is arranged inside the second room.

17. The developer supply device according to claim 1, wherein the wall is disposed between the roller and the agitator in a direction perpendicular to the first direction.

18. A developer supply device, comprising:

a roller configured to carry developer, extending in a first direction the first direction being in a direction of a rotation axis of the roller and horizontal when the developer supply device is in use;

a casing in which a first room and a second room are defined, the roller being disposed in the first room, the second room being configured to store the developer;

a wall extending over a length of the casing in the first direction, the first room and the second room being partitioned by the wall, an opening being formed above the wall over the length of the wall when the developer supply device is in use; and

an agitator configured to convey the developer from the second room to the first room, the agitator including a shaft and a rotating member fixed to the shaft, the shaft being rotatably supported by the casing and configured to rotate in the second room;

wherein the wall is divided into:

end portions which are both end portions, in the first direction, of the wall and having a first height at upper ends of the end portions; and

a central portion defined as a portion, between the end portions, having a predetermined length in the first direction and having a second height which is higher than the first height, the central portion having an upper end that is continuous with the upper ends of the end portions,

wherein the agitator is configured to convey the developer from the second room to the first room through at least a portion of the opening which is formed above at least the central portion of the wall,

wherein the developer conveyed over the wall accumulates in the first room,

wherein the roller is configured to collect the developer accumulated in the first room, and

wherein the rotating member of the agitator includes a central conveyance portion corresponding to the central portions of the wall and end conveyance portions respectively corresponding to the end portions of the wall, each of the end conveyance portions including a plurality of penetrating holes,

wherein the central conveyance portion has a different shape than the end conveyance portions so that a force to convey the developer from the second room to the first room is stronger by the central conveyance portion than by the each end conveyance portion,

wherein superfluous developer accumulated in the first room returns to the second room through at least portions of the opening which are formed above the end portions of the wall.

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